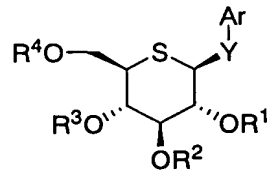
CLAIMS

1. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt thereof or a hydrate thereof:



(i)

[wherein

Y represents -O- or -NH-,

R^1, R^2, R^3 and R^4, which may be the same or different, each represent a hydrogen atom, a C_{2-10} acyl group, a C_{7-10} aralkyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkoxy-C_{2-10} acyl group or a C_{1-6} alkoxy-C_{2-6} alkoxycarbonyl group,

Ar represents an aryl group substituted with -X-A^1, in which the aryl group may further be substituted with the same or different 1 to 4 substituents selected from:

a halogen atom;

a hydroxyl group;

a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group;

a group represented by the formula:

$-(CH_2)m-Q$

{wherein m represents an integer of 0 to 4 and Q represents a formyl group, an amino group, a nitro group,

a cyano group, a carboxyl group, a sulfonic acid group, a C_{1-6} alkoxy group which may be substituted with 1 to 4 halogen atoms, a C_{1-6} alkoxy-C_{1-6} alkoxy group, a C_{2-10} acyloxy group, a C_{2-10} acyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkylthio group, a C_{1-6} alkylsulfinyl group, a C_{1-6} alkylsulfonyl group, -NHC(=O)H, a C_{2-10} acylamino group, a C_{1-6} alkylsulfonylamino group, a C_{1-6} alkylamino group, an N,N-di(C_{1-6} alkyl)amino group, a carbamoyl group, an N-(C_{1-6} alkyl)aminocarbonyl group, or an N,N-di(C_{1-6} alkyl)aminocarbonyl group}; or

a C_{3-7} cycloalkyl group, a C_{3-7} cycloalkyloxy group, an aryl group, a C_{7-10} aralkyl group, an aryloxy group, a C_{7-10} aralkyloxy group, a C_{7-10} aralkylamino group, a heteroaryl group, or a 4- to 6-membered heterocycloalkyl group, provided that each of these groups may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, a C_{1-6} alkyl group and a C_{1-6} alkoxy group,

X represents -(CH_2)n-, -CO(CH_2)n-, -CH(OH)(CH_2)n-, -O-(CH_2)n-, -CONH(CH_2)n-, -NHCO(CH_2)n- (wherein n represents an integer of 0 to 3), -COCH=CH-, -S- or -NH-, and

A^1 represents an aryl group, a heteroaryl group or a 4- to 6-membered heterocycloalkyl group, each of which may be substituted with the same or different 1 to 4 substituents selected from:

a halogen atom;

a hydroxyl group;

a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group;

a group represented by the formula:

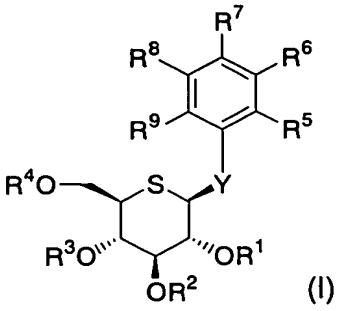
$$-(CH_2)m'-Q'$$

{wherein m' represents an integer of 0 to 4 and Q' represents a formyl group, an amino group, a nitro group, a cyano group, a carboxyl group, a sulfonic acid group, a C_{1-6} alkoxy group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group, a C_{1-6} alkoxy-C_{1-6} alkoxy group, a C_{2-10} acyloxy group, a C_{2-10} acyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkylthio group, a C_{1-6} alkylsulfinyl group, a C_{1-6} alkylsulfonyl group, -NHC(=O)H, a C_{2-10} acylamino group, a C_{1-6} alkylsulfonylamino group, a C_{1-6} alkylamino group, an N,N-di(C_{1-6} alkyl)amino group, a carbamoyl group, an N-(C_{1-6} alkyl)aminocarbonyl group, or an N,N-di(C_{1-6} alkyl)aminocarbonyl group}; or

a C_{3-7} cycloalkyl group, a C_{3-7} cycloalkyloxy group, an aryl group, a C_{7-10} aralkyl group, an aryloxy group, a C_{7-10} aralkyloxy group, a C_{7-10} aralkylamino group, a heteroaryl group, or a 4- to 6-membered heterocycloalkyl group, provided that each of these groups may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, a C_{1-6} alkyl group and a C_{1-6} alkoxy group].

2. A 5-thio-β-D-glucopyranoside compound of the

following formula or a pharmaceutically acceptable salt thereof or a hydrate thereof:



(I)

[wherein

Y represents -O- or -NH-,

R^1, R^2, R^3 and R^4, which may be the same or different, each represent a hydrogen atom, a C_{2-10} acyl group, a C_{7-10} aralkyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkoxy-C_{2-10} acyl group or a C_{1-6} alkoxy-C_{2-6} alkoxycarbonyl group, and

at least one of R^5, R^6, R^7, R^8 and R^9 represents -X-A^1 (wherein X and A^1 are as defined in claim 1) and the other, which may be the same or different, each represent:

a hydrogen atom;

a halogen atom;

a hydroxyl group;

a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group;

a group represented by the formula:

$-(CH_2)m-Q$

(wherein m and Q are as defined in claim 1); or

a C_{3-7} cycloalkyl group, a C_{3-7} cycloalkyloxy group,

an aryl group, a C_{7-10} aralkyl group, an aryloxy group, a C_{7-10} aralkyloxy group, a C_{7-10} aralkylamino group, a heteroaryl group, or a 4- to 6-membered heterocycloalkyl group, provided that each of these groups may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, a C_{1-6} alkyl group and a C_{1-6} alkoxy group].

3. The 5-thio-β-D-glucopyranoside compound according to claim 2, wherein Y is -O-, or a pharmaceutically acceptable salt thereof or a hydrate thereof.

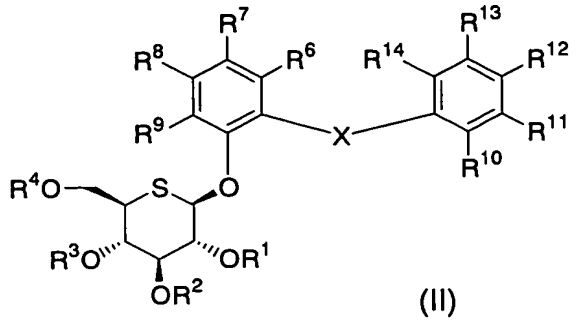
4. The 5-thio-β-D-glucopyranoside compound according to claim 2 or 3, wherein R^5 is $-X-A^1$, or a pharmaceutically acceptable salt thereof or a hydrate thereof.

5. The 5-thio-β-D-glucopyranoside compound according to claim 4, wherein X is $-(CH_2)n-$ (wherein n represents an integer of 0 to 3), or a pharmaceutically acceptable salt thereof or a hydrate thereof.

6. The 5-thio-β-D-glucopyranoside compound according to claim 4, wherein X is $-CO(CH_2)n-$ (wherein n represents an integer of 0 to 3), or a pharmaceutically acceptable salt thereof or a hydrate thereof.

7. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt

thereof or a hydrate thereof:



(II)

[wherein

X represents $-(CH_2)n-$, $-CO(CH_2)n-$, $-CH(OH)(CH_2)n-$, $-O-(CH_2)n-$, $-CONH(CH_2)n-$, $-NHCO(CH_2)n-$ (wherein n represents an integer of 0 to 3), -COCH=CH-, -S- or -NH-,

R^1, R^2, R^3 and R^4, which may be the same or different, each represent a hydrogen atom, a C_{2-10} acyl group, a C_{7-10} aralkyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkoxy-C_{2-10} acyl group or a C_{1-6} alkoxy-C_{2-6} alkoxycarbonyl group,

R^6, R^7, R^8 and R^9, which may be the same or different, each represent:

a hydrogen atom;

a halogen atom;

a hydroxyl group;

a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group;

a group represented by the formula:

$-(CH_2)m-Q$

{wherein m represents an integer of 0 to 4 and Q

represents a formyl group, an amino group, a nitro group, a cyano group, a carboxyl group, a sulfonic acid group, a C_{1-6} alkoxy group which may be substituted with 1 to 4 halogen atoms, a C_{1-6} alkoxy-C_{1-6} alkoxy group, a C_{2-10} acyloxy group, a C_{2-10} acyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkylthio group, a C_{1-6} alkylsulfinyl group, a C_{1-6} alkylsulfonyl group, -NHC(=O)H, a C_{2-10} acylamino group, a C_{1-6} alkylsulfonylamino group, a C_{1-6} alkylamino group, an N,N-di(C_{1-6} alkyl)amino group, a carbamoyl group, an N-(C_{1-6} alkyl)aminocarbonyl group, or an N,N-di(C_{1-6} alkyl)aminocarbonyl group}; or

a C_{3-7} cycloalkyl group, a C_{3-7} cycloalkyloxy group, an aryl group, a C_{7-10} aralkyl group, an aryloxy group, a C_{7-10} aralkyloxy group, a C_{7-10} aralkylamino group, a heteroaryl group, or a 4- to 6-membered heterocycloalkyl group, provided that each of these groups may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, a C_{1-6} alkyl group and a C_{1-6} alkoxy group, and

R^{10}, R^{11}, R^{12}, R^{13} and R^{14}, which may be the same or different, each represent:

a hydrogen atom;

a halogen atom;

a hydroxyl group;

a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group;

a group represented by the formula:

$-(CH_2)m'-Q'$

{wherein m' represents an integer of 0 to 4 and Q' represents a formyl group, an amino group, a nitro group, a cyano group, a carboxyl group, a sulfonic acid group, a C_{1-6} alkoxy group which may be substituted with 1 to 4 halogen atoms, a C_{1-6} alkoxy-C_{1-6} alkoxy group, a C_{2-10} acyloxy group, a C_{2-10} acyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkylthio group, a C_{1-6} alkylsulfinyl group, a C_{1-6} alkylsulfonyl group, -NHC(=O)H, a C_{2-10} acylamino group, a C_{1-6} alkylsulfonylamino group, a C_{1-6} alkylamino group, an N,N-di(C_{1-6} alkyl)amino group, a carbamoyl group, an N-(C_{1-6} alkyl)aminocarbonyl group, or an N,N-di(C_{1-6} alkyl)aminocarbonyl group}; or

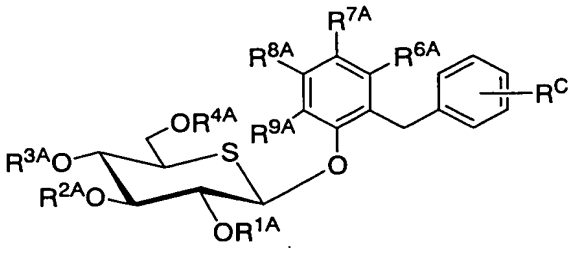
a C_{3-7} cycloalkyl group, a C_{3-7} cycloalkyloxy group, an aryl group, a C_{7-10} aralkyl group, an aryloxy group, a C_{7-10} aralkyloxy group, a C_{7-10} aralkylamino group, a heteroaryl group, or a 4- to 6-membered heterocycloalkyl group, provided that each of these groups may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, a C_{1-6} alkyl group and a C_{1-6} alkoxy group].

8. The 5-thio-β-D-glucopyranoside compound according to claim 7, wherein X is $-CH_2-$, or a pharmaceutically acceptable salt thereof or a hydrate thereof.

9. The 5-thio-β-D-glucopyranoside compound according to claim 7, wherein X is -O- or -NH-, or a pharmaceutically

acceptable salt thereof or a hydrate thereof.

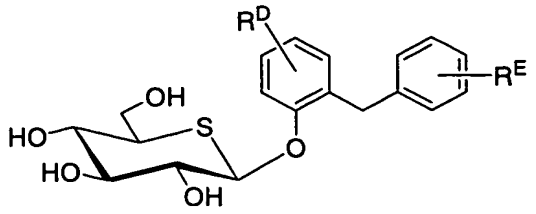
10. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt thereof:



(A)

(wherein R^{6A} to R^{9A}, which may be the same or different, each represent a hydrogen atom, a halogen atom, a C_{1-6} alkyl group, a C_{1-6} alkoxy group, a C_{1-6} alkoxy-C_{1-6} alkoxy group, a carboxyl group, a C_{2-6} alkoxycarbonyl group, a hydroxyl group or a hydroxy-C_{1-4} alkyl group, R^C represents a hydrogen atom, a halogen atom, a C_{1-6} alkyl group, a C_{1-6} alkoxy group, a hydroxy-C_{1-4} alkyl group, a halogen-substituted C_{1-6} alkyl group or a C_{1-6} alkylthio group, R^{4A} represents a hydrogen atom, a C_{2-6} alkoxycarbonyl group or a C_{2-6} alkanoyl group, and R^{1A} to R^{3A}, which may be the same or different, each represent a hydrogen atom, a C_{2-8} alkanoyl group or a benzoyl group).

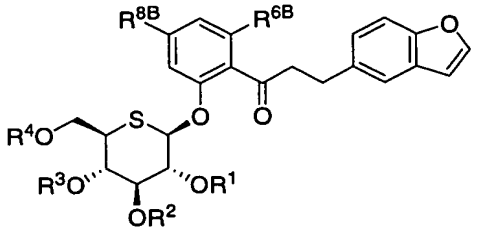
11. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt thereof:



(B)

(wherein R^D represents a hydrogen atom, a halogen atom, a C_{1-6} alkyl group or a hydroxy-C_{1-4} alkyl group, and R^E represents a hydrogen atom, a halogen atom, a C_{1-6} alkyl group, a C_{1-6} alkoxy group or a hydroxy-C_{1-4} alkyl group).

12. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt thereof or a hydrate thereof:



(C)

(wherein R^1, R^2, R^3 and R^4, which may be the same or different, each represent a hydrogen atom, a C_{2-10} acyl group, a C_{7-10} aralkyl group, a C_{2-6} alkoxycarbonyl group, a C_{1-6} alkoxy-C_{2-10} acyl group or a C_{1-6} alkoxy-C_{2-6} alkoxycarbonyl group, R^{6B} represents a hydrogen atom, a halogen atom, a hydroxyl group, a C_{2-10} acyloxy group, or a C_{1-6} alkyl or C_{1-6} alkoxy group which may be substituted with 1 to 4 halogen atoms, and R^{8B} represents a hydrogen

atom, a halogen atom or a C_{1-6} alkyl group which may be substituted with 1 to 4 halogen atoms).

13. A pharmaceutical preparation, which comprises the 5-thio-β-D-glucopyranoside compound according to any one of claims 1 to 12 or a pharmaceutically acceptable salt thereof or a hydrate thereof as an active ingredient.

14. The pharmaceutical preparation according to claim 13, which is an inhibitor of sodium-dependent glucose transporter 2 activity.

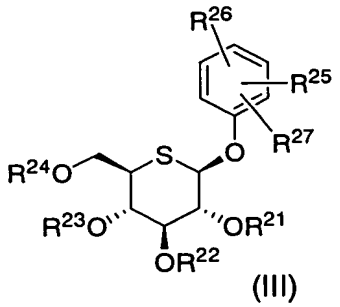
15. The pharmaceutical preparation according to claim 14, which is a prophylactic or therapeutic agent for diabetes, diabetes-related diseases or diabetic complications.

16. A pharmaceutical preparation, which comprises the 5-thio-β-D-glucopyranoside compound according to any one of claims 1 to 12 or a pharmaceutically acceptable salt thereof or a hydrate thereof, in combination with at least one drug selected from the group consisting of an insulin sensitizer selected from the group consisting of a PPARγ agonist; a PPARα/γ agonist; a PPARδ agonist; and a PPARα/γ/δ agonist, a glycosidase inhibitor, a biguanide, an insulin secretagogue, an insulin formulation and a dipeptidyl peptidase IV inhibitor.

17. A pharmaceutical preparation, which comprises the

5-thio-β-D-glucopyranoside compound according to any one of claims 1 to 12 or a pharmaceutically acceptable salt thereof or a hydrate thereof, in combination with at least one drug selected from the group consisting of a hydroxymethylglutaryl coenzyme A reductase inhibitor, a fibrate, a squalene synthase inhibitor, an acyl-coenzyme A:cholesterol acyltransferase inhibitor, a low-density lipoprotein receptor promoter, a microsomal triglyceride transfer protein inhibitor and an anorectic.

18. A 5-thio-β-D-glucopyranoside compound of the following formula or a pharmaceutically acceptable salt thereof or a hydrate thereof:



(III)

(wherein

R^{21}, R^{22}, R^{23} and R^{24}, which may be the same or different, each represent a hydrogen atom or a C_{2-10} acyl group,

R^{25} represents an amino group, a C_{2-6} alkanoyl group, a carboxyl group, a formyl group, a halogen atom, a C_{2-6} alkoxycarbonyl group or a hydroxyl group, and

R^{26} and R^{27}, which may be the same or different, each

represent a hydrogen atom, a halogen atom, a hydroxyl group, a C_{1-6} alkyl group which may be substituted with 1 to 4 substituents selected from the group consisting of a halogen atom and a hydroxyl group, or a C_{1-6} alkoxy group which may be substituted with 1 to 4 halogen atoms).